

JPRS 74039

20 August 1979

USSR Report

ENGINEERING AND EQUIPMENT

No. 58



FOREIGN BROADCAST INFORMATION SERVICE

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REPORT DOCUMENTATION PAGE	1. REPORT NO. JPRS 74039	2.	3. Recipient's Accession No.
4. Title and Subtitle USSR REPORT: ENGINEERING AND EQUIPMENT, No. 58		5. Report Date 20 August 1979	
7. Author(s)		6.	
9. Performing Organization Name and Address Joint Publications Research Service 1000 North Glebe Road Arlington, Virginia 22201		8. Performing Organization Rept. No.	
12. Sponsoring Organization Name and Address As above		10. Project/Task/Work Unit No.	
		11. Contract(C) or Grant(G) No. (C) (G)	
		13. Type of Report & Period Covered	
15. Supplementary Notes		14.	
16. Abstract (Limit: 200 words) The report contains articles, abstracts and news items on aeronautical, marine, mechanical, automotive, civil and industrial engineering, related research and development, and engineering materials and equipment.			
17. Document Analysis a. Descriptors USSR Aeronautics Industrial Engineering Marine Engineering Stress Analysis Turbines Metrology b. Identifiers/Open-Ended Terms c. COSATI Field/Group 1A, 13H, 13J, 14B			
18. Availability Statement Unlimited Availability Sold by NTIS Springfield, Virginia 22161		19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 50
		20. Security Class (This Page) UNCLASSIFIED	22. Price

20 August 1979

USSR REPORT

ENGINEERING AND EQUIPMENT

No. 58

This serial publication contains articles, abstracts of articles and news items from USSR scientific and technical journals on the specific subjects reflected in the table of contents.

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USSR

UDC: 621.375.8+533.9:621.039.61

DEVELOPMENTAL PROSPECTS OF LASER-DRIVEN FUSION POWER PLANTS

Moscow IZV AN SSSR, ENERGETIKA I TRANSPORT in Russian No 2, 1979 pp 3-8
manuscript received 27 Oct 78

BASOV, N. G., KROKHIN, O. N., ROZANOV, V. B., SHEYNDLIN, A. YE., GRIGOR'YANTS, R. R., KALININ, A. V. AND SHPIL'RAYN, E. E., Moscow

[Abstract] The principal aspects of the concept of a "pure" pulsed laser-driven fusion power station are considered, given the existing level of knowledge and technology and that anticipated for the next 10 years. A project jointly developed by the Physics Institute, USSR Academy of Sciences, and the Institute of High Temperatures, USSR Academy of Sciences, should provide some idea of such a station. The most promising laser system appears to be the CO₂ laser with a probable pulse energy of $5 \cdot 10^5$ joules and an efficiency of ≈ 3 o/o. Of the various concepts of the implosion chamber of the laser-driven fusion reactor, the "wet-wall" one, is thought to be the most promising. The project essentially represents an attempt to combine such a radically new heat source as the laser-driven fusion reactor with a standard K-300/240 boiler-turbine unit; the connecting link here would be a heat exchanger-steam generator of the "lithium-water" type with an economizer stage utilizing laser heat; the idea is to limit the amount of nonstandard equipment used and thus to enhance system reliability. The project is technologically feasible. Given the extremely high requirements for the laser system and fuel target, the cost per installed kwt would be at least twice as high at stations of this kind compared with fission power stations, but it should become commercially attractive if the cost of uranium increases about 50-100 percent or if the cost of fossil fuel increases 25-30 percent, considering that fuel is a negligible item in the cost of fusion power stations. References 3: all Western.

USSR

UDC 621.472:621.383 5

PHOTOVOLTAIC CELL WITH BILATERAL SENSITIVITY

Tashkent GELIOTEKHNIKA in Russian No 2, 1979 pp 3-8 manuscript received
4 Aug 78

ANOSHIN, YU. A., BORDINA, N. M., ZAYTSEVA, A. K., LETIN, V. A. and MILOVANOV, N. A., All-Union Scientific Research Institute of Current Sources, Moscow

[Abstract] The advantages of using an n⁺-p-p⁺ photovoltaic cell have been discussed lately: a thin photocell with such structure is more efficient than one with a single n-p junction. A barrier with like-conductivity junction (p-p⁺) reflects minority carriers of the base region (p layer), which is equivalent to reducing the effective rate of recombination on the rear surface of the base. Equations are derived for the current-voltage characteristics of a photocell with its illumination from the "rear" side and simultaneously from both sides. Type p silicon was selected having resistivity of 7.5 ohm-centimeters and at least 500 micron diffusion length of minority carriers; its thickness was 280-320 microns. Heavily doped n⁺ and p⁺ layers were formed by diffusion of phosphorus and boron. Small variations in effective rate of recombination can be produced by forming a p⁺ layer about 0.1 micron thick with a boron concentration equal to or greater than 10²⁰ cm⁻³ near the surface. Photocurrent density with rear illumination is over 80 o/o of that in front illumination. 2 figures; references 6: 3 Russian, 3 Western.

USSR

UDC 621.472

WIDE-BAND Ga_{1-x}Al_xAs:Si VARIBAND PHOTOVOLTAIC CELLS WITH ILLUMINATED n-REGION

Tashkent GELIOTEKHNIKA in Russian No 2, 1979 pp 9-12 manuscript received
27 Nov 77

BERKELIYEV, A., BESSOLOV, V. N., IMENKOV, A. N., NAZAROV, N., TSARENKOV, B. V. and YAKOVLEV, YU. P., Leningrad Physico-technical Institute imeni A. F. Ioffe and the Physico-technical Institute (Tashkent)

[Abstract] Reports have been published on the design of variband solar photovoltaic cells with an expanded range of spectral photosensitivity toward the short wavelengths based on solid solutions in the AlAs-GaAs system. It is worth using the n-layer of a variband Ga_{1-x}Al_xAs structure as the illuminated region, since the resistivity of n-Ga_{1-x}Al_xAs is about an order lower than that of p-Ga_{1-x}Al_xAs and the resistance of the ohmic contact to the n-layer is several times less than that of the contact to the p-layer. The structure

of the photoelectric cells was created by growing a layer of solid solution by the method of liquid epitaxy on a p-GaAs substrate oriented along the crystal plane using isothermal mixing of solutions and melts of Ga-As-Si and Ga-Al-As-Si. The high quantum photosensitivity of these structures in both the long and short wave regions of the spectrum proves the possibility of using $n\text{-Ga}_{1-x}\text{Al}_x\text{As}$ for the illuminated region in variband broad-band photoelectric cells and solar converters. 3 figures; references 2: 1 Russian, 1 Western.

USSR

UDC 621.472

PHOTOELECTRIC PARAMETERS OF PHOTOVOLTAIC CELLS AS A FUNCTION OF ILLUMINANCE

Tashkent GELIOTEKHNIKA in Russian No 2, 1979 pp 13-17 manuscript received 5 Aug 77

VINOGRADOVA, YE. B., GOLOVNER, T. M., GORODETSKIY, S. M. and KREYNIN, L. B.
All-Union Scientific Research Institute of Current Sources, Moscow

[Abstract] Photovoltaic cell short-circuit current is determined by the intensity and spectral composition of light falling on the device and the spectral distribution of photosensitivity, usually measured in A/W as the ratio of current to the power of light of a given wavelength incident on the device. The spectral distribution of sensitivity of the photoelectric cell is, in turn, set by the design of the device and its recombination characteristics. Several qualitative patterns of effect of the level of illumination on recombination, spectral and lux-ampere characteristics of silicon photoelectric cells are presented. Measurements presented showed that the often observed relationship of photosensitivity as a function of light intensity at illuminances of less than 140 mW/cm^2 is due to the presence of defects with a collective barrier. Studies of spectral photosensitivity under conditions of varied illumination raises the accuracy of the theoretical determination of photoelectric cell short-circuit current when illuminated by light with known intensity and spectral energy composition. 2 figures; 1 table; references 7: 5 Russian, 2 Western.

CALCULATION OF OPTICAL CHARACTERISTICS OF LARGE CAPACITY TWO-MIRROR SOLAR FURNACES

Tashkent GELIOTEKHNIKA in Russian No 2, 1979 pp 23-28 manuscript received 15 Mar 78

AZIMOV, S. A., MALLAYEVA, KH. M., PIRMATOV, I. I., RISKIYEV, T. T. and SULEYMANOV, S. KH., Physico-technical Institute imeni S. V. Starodubtsev, Uzbek Academy of Sciences

[Abstract] A general scheme of calculation of large solar furnaces is examined; methods of design and optimization of plans of arrangement of heliostats are proposed which can be used to plan turret-type solar electric power plants. Study of various versions of solar furnaces shows that the optimum scheme of a large solar furnace which meets the requirements imposed on solar furnaces used for technological purposes at about 300°C is the system consisting of a paraboloid mirror, concentrator and heliostat. The shape and size of the concentrator are chosen to allow for the purpose of the furnace, features of metal construction and power of the installation. The projection of the paraboloid to the plane perpendicular to the optical axis has the shape of a polygon. The maximum midsection, magnitude of solar radiation and sum coefficient of reflection determine the capacity of the solar furnace. Although each heliostat sends the concentrator almost an equal amount of energy, their share in shaping the radiant field in the working zone of the installation is different. This is because in this case the heliostat's efficiency depends on how far the zone of the concentrator illuminated by the heliostat is from the apex of the paraboloid. If we assume that the angle α within a single zone fluctuates only negligibly, it is easy to estimate the contribution of the heliostat to the overall illumination intensity in the focal zone of the concentrator. 2 figures; references: 9 Russian.

SOLAR CELL-BASED ON SnO_2 - SiO_2 -n-Si HETEROJUNCTION

Tashkent GELIOTEKHNIKA in Russian No 2, 1979 pp 83-84 manuscript received 19 Jul 78

BARANYUK, B. V., MALIK, A. I. and MANASSON, V. A., Chernovitsa Division of Semiconductor Materials Research, Branch of Mathematical Physics, Institute of Mathematics, Ukrainian Academy of Sciences

[Abstract] To produce inexpensive solar cells necessary under ground-based conditions, devices having a heterojunction formed by applying a transparent conductive layer of tin dioxide on a silicon substrate offer promise. MDS structures have been thoroughly investigated; using a thin insulation layer, no-load voltage can be increased by reducing dark saturation current and efficiency is enhanced as well. Solar elements investigated were created on the basis of n-type silicon with an orientation of (100) and resistivity of 1.3-1.7 ohm-centimeters. The diffusion length of carriers is equal to or greater than 0.1 mm. Ohmic contact to silicon was created by a Sn-Sb alloy. Specimens were 1 x 2 square centimeters and 0.3 mm thick. Chemical and dynamic etching were used to remove the surface layer of the silicon chip. A thin layer of silicon oxide was grown by thermal oxidation of the chip in air at 300-400°C for 10-20 minutes. The SnO_2 layers 500-1000 angstroms thick were produced by hydrolysis of an alcohol solution of $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$ on the surface of oxidized silicon chips heated to 300-400°C. One basic advantage of these solar cells is their increased sensitivity to the short-wave region of the solar spectrum. To simulate solar emission an incandescent lamp with a tungsten filament and a water heat filter were used. A silicon photoelectric cell with a p-n junction was used as the standard. To optimize the duty factor and efficiency of the devices, contacts to the conductive layer of tin dioxide should be optimized. 1 figure; references: 5 Western.

CIRCULAR FILM CONCENTRATOR WITH CONCENTRIC SEAM OF CONSTANT CURVATURE

Tashkent GELIOTEKHNIKA in Russian No 2, 1979 pp 85-86 manuscript received 12 Mar 78

KAMIL'DZHANOV, A. KH., Tashkent Institute of Engineers of Railroad Transportation

[Abstract] A circular film reflector is considered for the case where the seam line, like other parts of the reflective surface, is deformed and its cross section acquires the shape of the arc of some circle with a given

radius. Equations are derived to determine type of edge clamping, limitation of buckling at the center, continuity of flexures, and deformation of the seam line about the circle. A circular film concentrator of solar energy with deformed concentric seam of constant curvature provides a reflecting surface whose shape will coincide with that of a paraboloid of rotation which will be acquired by a round membrane of radius R clamped around its edge under the influence of a pressure differential. 2 figures; references: 2 Russian.

USSR

UDC 621.472

CONCENTRATING SYSTEM OF AUTONOMOUS SOLAR POWER ENGINEERING DEVICE

Tashkent GELIOTEKHNIKA in Russian No 2, 1979 pp 87-88

UMAROV, G. YA., ALIMOV, A. K., KHODZHAYEV, A. SH., ABDUAZIZOV, A., and KHASANOV, R. B., Physico-technical Institute imeni S. V. Starodubtsev, Uzbek Academy of Sciences

[Abstract] The results of developments and research of optical energy characteristics of solar energy concentrators of autonomous solar energy equipment using Stirling engines are examined. Thermal power on the order of 4.5-5 kW is achieved with a maximum midsection surface on the concentrator of at least 10 square meters. The concentrator is generally faceted; to make it portable, it is modular. The reflecting surface of the concentrator consists of 24 paraboloid glass facets with square planform (600 x 600 mm). The facets are set in frames with flexible gaskets attached to the housing of the concentrator with four special bolts. Adjustment screws permit motion for accurate installation of facets. The focal length of the facets depends on their position on the carrier base. An aluminum reflective coating is applied by thermal evaporation in a vacuum on the rear side and is protected by a lacquer coating. The concentrator suspension system is azimuthal-zenithal. Optical and thermal characteristics of the system were studied: 4.55 kW capacity, average flux density in the focal spot is 260 kW/m^2 , average absolute blackbody temperature in the focal point is 1170 K. This concentrator supports thermal loads sufficient to drive a Stirling type engine. 2 figures; references: 5 Russian.

USSR

UDC: 621.313.322-81:537.31262.001.2

MAXIMUM MAGNETIC INDUCTION IN THE SUPERCONDUCTING EXCITATION WINDING ZONE OF CRYOTURBOGENERATORS

Moscow IZV AN SSSR, ENERGETIKA I TRANSPORT in Russian No 2, 1979 pp 80-86
manuscript received 10 Apr 78

DZBATDOYEV, A. O., ZIL'BERSHTEYN, L. A. and KRASHNIKOV, A. M., Moscow

[Abstract] In cryogenerators with superconducting excitation windings (SEW) knowledge of the distribution of resultant magnetic field induction over the entire volume of the winding is important to the solution of design and engineering problems. In this connection, formulas for calculating magnetic induction are presented on the basis of an analytic solution of the problem of the magnetic field of an infinitely long machine with a ferromagnetic core of infinitely large inductivity. With the aid of computerized analysis and approximation of rated data, a sufficiently simple method for determining maximum magnetic induction in the zone of rectilinear sections of the excitation winding is developed and presented. Experimental and theoretical findings indicate that, as a rule, magnetic induction in a superconducting excitation coil reaches its maximum at the inside surface of the coil in the neighborhood of the inner cylindrical boundary. The new computing method is of acceptable accuracy (5-7 percent). Figures 6; references 4: all Russian.

USSR

UDC 65.011.56

AUTOMATED CONTROL OF TECHNOLOGICAL PROCESSES OF A 300 MEGAWATT ENERGY UNIT BASED ON AKESR EQUIPMENT

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 5, 1979 pp 23-25

KOPCHENOV, O.V., DICHYUS, R. I. and DANTA, YU. P.

[Abstract] The automation target is a 300 MWt double energy unit with a type TGMP-114 boiler-type direct flow double-casing unit with K-300-240 turbine. Main components of the energy unit regulator are: information system, operating personnel control media group, boiler main regulator, turbine regulator, "sliding" mode control, and mode selector. AKESR equipment permitted realization of entire system of power regulation with a small amount of equipment, all standard devices. Lithuanian GRES equipment was first to be incorporated in the Soviet system; it is difficult to draw conclusions about its reliability. There are 90 automated control systems of varying complexity required to automate the 300 MWt energy unit: this required the entire complement of AKESR equipment. 1 figure.

ELECTROTHERMAL FIELD OF THE ROTOR SHIELDS IN A CRYOTURBOGENERATOR

Kiev DOPOVIDI AKADEMIYI NAUK UKRAYINS'KOYI RSR, SERIYA A FIZYKO-MATEMATYCHNI TA TEKHNICHNI NAUKY in Ukrainian No 5, May 78 pp 377-381 manuscript received 12 Jun 78

SCHASTLYVYY, H. H., TITKO, O. I. and SHNYR'OVA, S. M., Institute of Electrodynamics, Academy of Sciences of the Ukrainian SSR

[Abstract] A new kind of electrical machine is considered, namely an a.c. turbogenerator with a superconductor excitation winding and cryogenic (helium) cooling. The rotor cryostat requires shields which must be designed to perform also under anomalous operating conditions. Accordingly, on the assumption that only axial currents flow in the rotor winding, the radial temperature profile as a function of the electric field intensity $T(r, E)$ and the radial field profile as a function of the temperature $E(r, T)$ are determined from the differential equation of the electrothermal field with appropriate boundary conditions. Furthermore, the temperature dependence of the critical shield dimension is established. On the basis of the results of a numerical solution, shields are designed in terms of radius and thickness for temperatures ranging from 300 to 20 K at a specific machine loading of 1130 A/cm. The article was presented by academician G. Ye. Pukhoviyy (Academy of Sciences of the Ukrainian SSR). Figures 1; tables 2; references 6 (Russian).

USSR

DEVELOPMENT OF A 1000 MW STEAM-GAS FACILITY WITH PRESSURIZED GASIFICATION OF SOLID FUEL

Moscow ENERCOMASHINOSTROYENIYE in Russian No 2, Feb 79 p 46

[Abstract] The Scientific and Technical Council of the Ministry of Power Machinery of the USSR has approved continuation of work on a 1000 MW steam-gas facility with pressurized gasification of solid fuel. The greatest difficulty is in developing gas generators that will handle 60 metric tons of solid fuel per hour with gas purification systems. To expedite the work, it is recommended that full-scale gas generator modules be developed in an experimental industrial steam-gas facility with standard power equipment: the T-180-130 steam turbine, a gas-turbine generator based on the GT-45-850 gas turbine, and a high-head steam generator based on VPG-600-545/545 modules. Other versions should also be developed. The steam-gas facility must be compatible with equipment standardized for nuclear and fossil-fuel electric plants.

INCREASING THE MANEUVERABILITY OF BASIC FOSSIL-FUEL PLANTS POWER

Moscow TEPLOENERGETIKA in Russian No 4, Apr 79 pp 17-21

GIRSHFEL'D, V. YA., and KHANAYEV, V. A., candidates of technical sciences, VOLKOVA, YE. D., GORELOV, V. A., and GERSHENKROY, M. L., engineers, Moscow Institute of Power Engineering, Siberian Institute of Power Engineering, Siberian Branch, USSR Academy of Sciences, Pridneprovsk Regional Electric Powerplant

[Abstract] The primary trend for the future development of power systems for the European portion of the unified power network is seen as the construction of specialized semi-peak power units, as well as modernization of base power units in order to make them more maneuverable. The switch from oil to powdered coal as fuel will require that some power units be shut down each day during low-load times. Virtually no experience has been gained in this mode of operation. 150 and 200 MW power units can be used to regulate the power generation in the European portion of the nationwide network, since the turbines of these modern units can be largely unloaded while maintaining the minimum head in the steam-generating units. Figures 4; references 4 (Russian).

SOME TRENDS IN THE DEVELOPMENT OF SYSTEMS FOR REGULATION AND PROTECTION OF STEAM TURBINES

Moscow TEPLOENERGETIKA in Russian No 4, Apr 79 pp 36-40

KALASHNIKOV, A. A., candidate of technical sciences, Moscow Institute of Power Engineering

[Abstract] A study is made, primarily on the basis of published patent information, of several trends of research concerning the control of steam turbines. As the main control loop of a steam turbine becomes more nearly perfected, automatic changes in the gain and time constants, and inclusion or exclusion of various connections in the transient process must be considered more promising trends for further development. A regulation system with a variable gain factor is diagrammed and discussed. It has also been suggested that the connections between the automation subsystems of various parts of the power-generating installation be made more comprehensive. Many of the suggestions which have been made will introduce additional nonlinearity to control, requiring great attention to problems of adjustment and more general methods of investigation of the systems of regulation of steam turbines. Figures 5; references 39: 36 Russian, 3 Western.

THE OR-12PV STEAM TURBINE FOR DRIVING OF BLAST FANS OF POWERFUL GAS-OIL, GAS-TIGHT POWER UNITS

Moscow TEPLOENERGETIKA in Russian No 4, Apr 79 pp 40-44

LUKASHEVICH, V. E., BRUSHITSYN, N. A., LUKASHENKO, UR. L., Engineers

[Abstract] The 800 MW gas-oil power units of the Zaporozh'ye and Uglegorsk Regional Electric Powerplants utilize blast fans with steam turbine drives, two per power unit, for the first time in Soviet practice. The OR-12PV steam turbine, produced at the Kaluga Turbine Plant, is used to drive the blast fans. The nominal power rating of the turbine is 6440 kW at a speed of 6,000 rpm. Analysis of the operating conditions of the turbine in the 800 MW power unit shows that the turbine must operate over a broad range of initial and final steam parameters with a range rotor speeds significantly greater than the depth of speed regulation when the 800 MW power units operate at the nominal parameters of live steam, and even greater than the PT OR-12PM used with the 300 MW power units and sliding live steam parameters. A diagram of the drive turbine is presented. A schematic diagram of the oil supply to the drive turbine is also presented. The devices are now in successful operation, and the experience gained in designing them can be used for the development of new power engineering equipment. Figures 6; references 3 (Russian).

USSR

UDC 553.002.2/624.154

WORKABLE DESIGN OF FOUNDATIONS LAID IN PERMAFROST SOILS

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 4, 79 pp 21-22

STRUBTSOV, YU. A., Tyumen', Main Tyumen' Petroleum and Gas Deposits Construction Administration, and TISHIN, V. G., Ukhta Affiliate of the All-Union Scientific Research Institute of Trunk Pipeline Construction

[Abstract] Based on an analysis of numerous designs of petroleum and gas industry facilities a formula for the quantitative criterion of reliability of the natural soil foundations is presented. The principal requirements for pile foundations to be sunk into permafrost soils such as those in Ukhta (low material requirement, mechanizability, operating reliability) are satisfied by foundations consisting of wedge-shaped units assembled on site from slabs. In weak soils these foundations operate on the hollow-pile principle. Their high loadbearing strength is assured through the forces of friction of soil against the exterior lateral surfaces and owing to the resistance of the earthen core within the unit. Fairly dense installation of these units assures soil stability by preculding slip. Three methods of alignment of these wedge-shaped piles in permafrost soils are proposed: a) placement in a pit to be frozen into the soil; b) placement in a layer of freshly poured soil; c) installation in layer of freshly poured soil in the capacity of ventilating facilities. Coolant-filled tubing can be added to speed up the adhesion of the piles to the soil through freezing. If holes are drilled in the slabs covering the wedge-shaped piles, this will result in the formation of frozen ice-and-soil plugs which will still further increase the loadbearing capacity of the piles. These techniques are particularly effective in the construction of prefabricated structures which then reduces to assembling them at the designed level on a surface shored up by the wedge-shaped piles which prevent heat from reaching the permafrost soil. When the load on the base is considerable, cooling ducts represented by sufficiently strong hollow wedge-shaped units can be installed in between the series of piles. The required rate of motion of air in these ducts is determined by thermodynamic calculations and assured by wind pressure (natural ventilation) or by using fans (forced ventilation) installed in the ducts. Slabs and wedge-shaped piles can also be used in the construction of roads and reservoirs in weak soils. A broad introduction of these designs requires developing the technology of the production of slabs from local materials and determining the most effective method for sinking wedge-shaped foundations into permafrost soil. Figures 3.

USSR

UDC 621.822.5.033

EXPERIENCE IN THE DESIGN OF STATIC GAS BEARINGS

Moscow VESTNIK MASHINOSTROYENIYE in Russian No 4, Apr 79 pp 41-43

LUCHIN, G. A., SIDORA, N. N., candidates of engineering sciences, and SEMENOV, V. A. engineer

[Abstract] Structural design approaches to increasing the service life of gas bearings are based on choosing an optimum variant of the gas supply components, providing for self-sealing as well as vibrational stability and emergency protection of the bearing assembly. Emergency protection in the case of supply failure is the most poorly handled aspect of present design. Ways of increasing the supply reliability for various radial thrust gas bearings are described. These include duplicating the gas lubricant feed lines, additional fine scrubbing of the gas at the input to the bearing assembly, exhaust channels for removing dirt from the working gap, using inserts of an antifriction material, as well as heat insulation and thermal compensation of the support assembly. An improved turbocompressor design is described and the possibility of producing such thrust bearings with increased reliability and improved operating characteristics is indicated. Figures 5; references: 1 Russian.

USSR

UDC 621.822.57(043.3):621.89

VACUUM ION-PLASMA METHODS OF TREATING THE WORKING SURFACES OF BEARINGS WHICH OPERATE WITH A GAS LUBRICANT

Moscow VESTNIK MASHINOSTROYENIYE in Russian No 4, Apr 79 pp 52-55

SEMEV, A. P., doctor of engineering sciences and VORONIN, N. A., candidate of engineering sciences

[Abstract] A general discussion of methods of applying thin coatings to bearing surfaces by such means as cathode sputtering, ionic alloying or implantation, ionic precipitation, thermal vacuum evaporation and various combinations of these is followed by an analysis of experimental results for various bearing materials. Coatings of stearic and behenic acids, calcium stearate and stearic amide were studied. The bearing materials were Al_2O_3 and VK6-OM hard alloy. Boundary layers of the solid lubricant were applied by dipping, thermal vacuum evaporation and a combined procedure using ion sputtering in conjunction with dipping or thermal evaporation, and friction tests were made for ceramic on ceramic and ceramic on hard alloy. The thickness of the lubricating coating was one to three monolayers. Annular samples which periodically made contact at the end faces were used, where the slip

velocity was 3.1 cm/s, the frequency of the periodic contacts was 0.835 s⁻¹, the duration of the contact was 0.4 s and the number of contact cycles was 10,000. The coefficient of friction for the samples is plotted as a function of the number of contacts and the lubricant material, method of applying the lubricant and other parameters are summarized in tabular form. The greatest service life was found for the combination method of ion sputtering and thermal vacuum evaporation due to the high degree of adhesion of the coating applied by vacuum methods. Figures 4; references: 8 Russian; 1 Western.

USSR

UDC 621.007.52

PARAMETRIC AND DIMENSIONAL CLASSIFICATION OF INDUSTRIAL ROBOTS

Moscow IZVESTIYA VUZ, MASHINOSTROYENIYE in Russian No 5, 79 pp 42-46 manuscript received 21 Mar 78

PAVLENKO, I. I. and KAMYSHNYY, N. I., Moscow Higher Technical School imeni Bauman and Kirovograd Institute of Agricultural Machine Building

[Abstract] The upsurge in the manufacture of industrial robots requires sound classification in terms of weightlifting capacity, precision of positioning and magnitude of displacement of mobile members, such as would assure the fullest possible correspondence with the parameters of the serviced equipment and objects handled by robots. The operations most often handled by robots are loading and unloading, transportation and warehousing, assembling, and other operations in which the objects handled are parts and components. The parts most often handled in machine building are solids of revolution with 93% of their total number being no longer than 500 mm and 97% having a diameter of less than 250 mm. Hence the majority of automatic equipment and industrial robots is used to handle such parts. These parts are divided into dimensional groups according to size of tolerances. Analysis of the diameter intervals of these parts shows that most of them fit closely the dimensions of the manipulating limbs of industrial robots, and that the parametric classification of the hoisting capacities of the robots should follow a geometrical progression based on a denominator of 1.6, with the robots themselves being correspondingly classified as microrobots (up to 0.1 kg hoisting capacity), minirobots (from 0.1 to 1 kg), light robots (from 1 to 10 kg), medium robots (from 10 to 100 kg); heavy robots (from 100 to 1000 kg), and superheavy robots (more than 1000 kg). The precision of positioning (maximum error of the movement of the robot's hand-grip) is similarly determined according to size tolerances of the surfaces being assembled and also follows a geometrical progression with denominator of 1.6. Robots in the R5 series are correspondingly classified into normal, upper, high, and extra high precision groups and classes. Tables of parametric and dimensional correspondences between robot hoisting capacity and precision of positioning, on the one hand, and the technical characteristics of the equipment serviced are presented. The proposed classification thus should assure a fuller exploitation of the functional potential of industrial robots. Figures 1; references 5 (Russian).

USSR

UDC 621.224.001.5

SOME RESULTS OF RESEARCH AND DEVELOPMENT ON EQUIPMENT LAYOUTS FOR HORIZONTAL AXIAL WATER TURBINES

Moscow ENERGOMASHINOSTROYENIYE in Russian No 12, Dec 78 pp 16-18

VARLAMOV, A. A., engineer, KUZMINSKIY, S. S., engineer, Lenin Prize Laureate, and IVLEV, A. G., engineer, Leningrad Metal Plant Turbine Building Production Association

[Abstract] The authors give the results of tests of a water turbine runner with type PL548 vane system developed at Leningrad Metal Plant. Different equipment layouts were tested on the same stand, with the same size of the runner in the model and with identical methods of measuring the quantities necessary for determining efficiency. It was found that in the case of axial horizontal turbines the best performance from an energy standpoint is shown by a turbine of capsule type with upper placement of the capsule, a conical guide-vane assembly and bracket runner mounting. The mounting elements for the capsule and the turbine runner, which are situated in the flow channel, are sources of considerable energy losses and require careful design as well as economic and energy calculations to justify their necessity. The power and cavitation characteristics of capsule turbines are considerably influenced by the shape and relative dimensions of the meridional section of the flow channel in the vicinity of the guide vane assembly and the runner. Figures 5; references 3 (Russian).

USSR

UDC 621.163.001.24

ENGINEERING DETERMINATION OF FORCES TRANSMITTED TO THE SUPPORTS AND FOUNDATION OF A TURBOGENERATOR WITH SUDDEN ROTOR IMBALANCE

Moscow ENERGOMASHINOSTROYENIYE in Russian No 12, Dec 78 pp 18-20

APLAN, D. M., engineer, LAVROV, V. V., engineer, KONSON, YE. D., candidate of technical sciences, Leningrad Metal Plant Turbine Building Production Association

[Abstract] A solution is found for the problem of vibrations of a multi-sectional rotor under the effect of sudden imbalance. This enables determination of the distribution of forces with respect to the supports of a turbo-generator, and evaluation of the mutual influence of turbine rotors. It is assumed that the supports are isotropic (the compliances of the supports are the same in the vertical and horizontal directions). Forces of friction in

the shafting are disregarded (an adjusted damping factor accounts for damping of the bearing post and oil layer). An ALGOL-60 program is used for calculating flexures and forces in the transient process caused by abrupt loading. An example is given for imbalance caused by detachment of a wheel vane. Figures 2; references 4 (Russian).

USSR

UDC 621.165

THE K-1200-240-3 STEAM TURBINE--A NEW STAGE IN THE DEVELOPMENT OF SOVIET TURBINE CONSTRUCTION

Moscow ENERGOMASHINOSTROYENIYE in Russian No 2, Feb 79 pp 2-6

SHISHOV, G. A., Director General of the Leningrad Metal Plant Turbine Building Production Association, OGURTSOV, A. P., KRUGLOV, P. V., RYZHKOV, V. K., ANTONOV, S. N., MERKULOV, V. V., BEGUNOV, N. N., ANFIMOV, V. M., PICHUGIN, I. I. and KHOKHULIN, V. N., engineers

[Abstract] The development of the K-1200-240-3 steam turbine has opened a new phase in Soviet power engineering. The new unit will be the base for a series of high-power turbines that operate on both fossil and nuclear fuels. The turbine is a single-shaft five-cylinder unit that includes a high-pressure cylinder, a double-flow medium-pressure cylinder and three double-flow low-pressure cylinders. The turbine is designed for operation with an initial steam pressure of 240 kgf/cm² and temperature of 540°C, and has one intermediate superheating of the steam to 540°C. The pressure in the condenser under rated conditions is 0.039 kgf/cm² with cooling water temperature of 12°C. At the rated turbine power of 1200 MW, provision is made for peak loading by disconnecting the high-pressure heaters, and also for developing a power of 1400 MW for prolonged periods. The overall length of the turbine without generator is 47.9 m, and with the generator--71.8 m. The total mass of the turbine is about 1900 metric tons (without the condenser, auxiliary equipment and pipelines). The major distinguishing features of the turbine are a new low-pressure cylinder design with unique exhaust that uses a titanium alloy working vane 1200 mm long, a welded low-pressure rotor massing 80 metric tons, intrachannel moisture separation in the diaphragms of the last stage, and placement of supporting elements in bearing cases that are installed directly on the foundation. The K-1200-240-3 turbine is superior to earlier designs in technical and economic indices. The unit requires lower capital investments and overhead expenses and will give the consumer considerable savings when used in place of the K-800-240-2 turbine. The authors discuss the experience acquired in manufacturing the new superpower turbine. Figures 3; references 3 (Russian).

INVESTIGATION OF THE DYNAMIC STRENGTH OF TURBINE WORKING VANES

Moscow ENERGOMASHINOSTROYENIYE in Russian No 2, Feb 79 pp 9-12

BOGORADOVSKIY, G. I., OSTROVSKIY, L. I., STEPANOV, A. M., candidates of technical sciences, and OSTASHKOV, A. I., engineer, Neva Plant Production Association imeni V. I. Lenin

[Abstract] Studies are done on dynamic stresses in the vanes of a turbine with maximum useful power of 10 MW. Analysis of experimental data showed that stresses are distributed fairly uniformly through the vane for the first five modes of vibration. For the sixth mode, the stresses in the peripheral section close to the trailing edge are two or three times the stress level in other parts of the blade. If part of the trailing edge is cut off in these sections, the nonuniformity for this mode is smoothed out, and there is little change in any of the preceding modes. Leveling the stress distribution reduces the maximum stress amplitude in the working machine. All frequencies of normal modes increased after trimming the edge. Laboratory tests show resonances of the fundamental at multiples of 5, 9, 10 and 11 in the vicinity of the working speed, and also resonances with frequencies $f=nz$, where n is the rpm and z is the number of vanes. The maximum stresses developed on the sixth natural frequency. Stresses are low under no-load conditions, and reach a maximum at half load, remaining essentially on the same level up to maximum load. It is shown that stresses can be reduced by trimming the trailing edges of the blades and increasing axial clearance. These steps do not reduce turbine efficiency. Figures 5; references 2 (Russian).

A TURBINE RUNAWAY PROTECTOR

Moscow ENERGOMASHINOSTROYENIYE in Russian No 2, Feb 79 pp 12-15

RED'KO, YU. P., candidate of technical sciences, ALEKSANDROVSKIY, G. G., BELOSTOTSKIY, M. B., ZIMICHEV, YU. I. and ROSHAL', M. D., engineers

[Abstract] A turbine runaway protector is described. The device was developed by the Khar'kov Turbine Plant imeni S. M. Kirov in cooperation with Khar'kov Polytechnical Institute. The protector is automatically activated when 50% or more of the turbine load is instantaneously dropped. The design incorporates a relay forcing unit, a pulsator and a differentiator module. When the air circuit breaker drops out, the relay forcing unit shapes a current pulse that closes the regulating valves. The pulsator is a square pulse oscillator that keeps the slide valve of a fluidic amplifier oscillating at

a predetermined frequency and amplitude. The signal from the output of this oscillator is applied to the control winding of the magnetic amplifier in the relay forcing unit. The differentiator module produces a signal proportional to the rotor acceleration. Tests of the protector have shown that it is reliable in operation without false alarms. The device was put into industrial operation on a K-500-240 turbine at the Troitskiy State Regional Power Plant in 1977. Figures 3; references 6 (Russian).

USSR

UDC 621.45.620.178.162

INCREASING THE WEAR RESISTANCE OF FUEL INJECTION SYSTEM COMPONENTS OF GAS TURBINE ENGINES

Moscow VESTNIK MASHINOSTROYENIYE in Russian No 4, Apr 79 pp 13-17

AKSENOV, A. F. doctor of engineering sciences, DOBROVOL'SKAYA, M. F., engineer, and LITVINOV, A. A., candidate of engineering sciences

[Abstract] Plunger type pump regulators operating at elevated fuel pressures are the most heavily loaded components of engine fuel feed systems, where the plunger spheres and the cone surface of the inclined washer bearing cage are subject to the greatest wear. The results of studies of the processes occurring on the metal surfaces of these components with friction in T-7, RT and TS-1 fuels using electron and scanning microscopy as well as X-ray spectral microanalysis are presented. The sloped washer in the trials was fabricated from ShKh15 steel and the plunger from KhVg steel. The tests were run for 100 hours using the commercial fuels. The wear of the washer in T-7 fuel was 0.15 mm, and for the plungers was 0.82 mm; in the RT fuel which was obtained from T7 by adding 0.003 percent of a surface active agent, the washer wear was 0.025 mm and plunger wear was 0.06 mm. The reduced wear is explained by the reduction in the rate of oxidation wear occurring on the surface of the metal with friction in a fuel cleaned of hetero-organic compounds, however, the thin adsorption layers formed with the interaction of the surface active agent and the metal cannot prevent undesirable adhesion processes in a region of elevated contact loads. In the presence of the surface active agent a transfer of tungsten from steel with a tungsten concentration of 1.6 percent (KhVG) to the steel which does not contain tungsten (ShKh15) is observed. The problem of increasing the wear resistance of the components can be solved through a comprehensive approach; the use of surface active additives to reduce the rate of oxidation wear as well as the prevention of seizing phenomena by applying protective coatings to the contact surfaces. Figures 5; references 4: 3 Russian; 1 Western.

USSR

UDC 621.472:621.383.5

ANALYSIS OF OPTICAL CHARACTERISTICS OF SILICON PHOTOVOLTAIC CELLS WITH BILATERAL SENSITIVITY

Tashkent GELIOTEKHNIKA in Russian No 2, 1979 pp 18-22 manuscript received 8 Dec 77

ZAYVLIN, V. R., LETIN, V. A. and KHOLEVA, N. M., All-Union Scientific Research Institute of Current Sources, Moscow

[Abstract] The optical characteristics of photovoltaic cells with bilateral sensitivity are analyzed to evaluate the efficiency of their manufacturing technology, to calculate the equilibrium temperature of the photocells with illumination from both sides allowing for the thermal radiation and albedo of the Earth. The photocells in question are coated on both sides with an anti-reflection film of ZnS and lacquer which permits an increase in its short-circuit current for operation in the extraterrestrial sunlight by 40-42 o/o. One means of increasing photoelectric cell efficiency is to lower its operating temperature. Spectral coefficients of reflection and transmission of bilateral photoelectric sensors were studied in the IR region of the spectrum (0.8-0.50 micron). A shift in the maximum in the reflection spectrum toward longer wavelengths and the less steep rise in the coefficient of reflection as compared with other curves proves the lower surface concentration of the phosphor and less extensive region where the carrier concentration is maximum and constant. A depth of alloying of the p-n junction equal to 1.2-1.5 microns does not provide high efficiency of carrier collection in the alloyed region and attainment of peak photocurrents on the facial side. 5 figures; references 7: 5 Russian, 2 Western.

USSR

UDC 621.997

DEVICE FOR MEASURING SPECTRAL EMITTANCE OF HIGH-TEMPERATURE MATERIALS

Tashkent GELIOTEKHNIKA in Russian No 2, 1979 pp 40-42

NAVASHEV, YU. Z., NECHAYEVA, L. V., ARIFOV, P. U., KULAGIN, A. I. and MUDZHAYEVA, T. N., Institute of Electronics imeni U. A. Arifov, Uzbek Academy of Sciences

[Abstract] Devices were designed and methods were developed to investigate thermophysical properties of refractory and heat-resistant materials in the region of high temperatures using concentrated solar emission. Using a solar furnace with a 1.5 meter diameter and horizontal optical axis, a device was constructed to measure the spectral coefficient of reflection, spectral normal emittance and actual temperature of materials at temperatures above

1000°C up to and including the melting point. The device operates on the Laszlo method. The device consists of a paraboloid concentrator, radiant flux filter, counterweight, synchronously rotating disks with apertures, adjustment for changing the juxtaposition of disks, flywheel and motor, radiant flux regulator, specimen holder, standard and optical pyrometer. The degree of blackness measured near the melting point was 0.76. Differences in values of $\epsilon\lambda$ are attributed to the fact that specimens have different chemical composition. Specimens were cast, diameters were 22-22.5 mm, thickness 3-3.2 mm. Measurements were made in the temperature range 1500-1700°C: in this range, $\epsilon\lambda$ increases in direct proportion to temperature from 0.15 to 0.35. Values of $\epsilon\lambda$ measured for specimens of electrode graphite at 1750°C are equal to 0.97, with error at 10-12 o/o. 1 figure; references: 3 Russian.

USSR

UDC 778.4:621 373.826

THE PHOTON HOLOGRAPHIC READER-COPIER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978 pp 27-30 manuscript received 1 Jun 77

VAGIN, L. N., FILATOV, A. M., YERSHOV, A. YU. and RUMYANTSEV, V. A.

[Abstract] A simple, compact reader is necessary to evaluate the quality of holograms when a relatively small volume of holographic document microforms is used. Current readers have several shortcomings, including matte glass viewing surfaces, large diameter lenses. The new device is free of these shortcomings. The new reader is a desk-top unit with a liquid crystal display. Laser scanning is used to image the hologram on the LCD. Memory capacity is 3000 holograms, each 1-2 mm in diameter. The LCD is 170 x 220 mm in size and the entire unit weighs 32 kg. The lens used is the Yupiter-3. In this holographic reader and copier, the enlarged image of the document is focused on the screen by a microhologram without external optics and without fine adjustment of definition. Document copying and reading are done simultaneously. The dynamic scattering of light in liquid crystals is used to suppress speckle pattern. 4 figures; references 4: 3 Russian, 1 Western.

SCANNING ELECTRON MICROSCOPE WITH HIGH ELECTRON ENERGY

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 30-35 manuscript received 12 Dec 77

VASICHEV, B. N.

[Abstract] New transmitting-type electron microscopes with electron energies of 70 keV to 3 MeV and scanning electron microscopes with maximum electron energies from 15 keV to 1 MeV have been developed as tools to investigate the structure, phase composition and chemical uniformity at the atomic level of new materials. The lack of suitable linear accelerators is a roadblock to the further upgrading of transmitting-type electron microscopes. The scanning electron microscope is a more flexible device than the transmitting type and may be designed on the basis of modern microwave linacs. It also permits examination of very thick solids and gases, converts image contrast and definition and permits formation of stereoscopic images. The scanning electron microscope uses magnetic lenses with iron cores and provides a resolution of 0.2-0.5 nanometers. The high localization and current density of the electron probe reduces the time needed to study the process of formation of radiation defects. By controlling the position of the electron beam, it may be used to irradiate semiconductor devices to study process of local formation of electrically active structural defects that influence the concentration of majority carriers and recombination of nonequilibrium current carriers which enhance the speed of semiconductor devices. 3 figures; references: 2 Western.

VIDEO MONITOR WITH COLOR-CODE REGISTRATION FOR ELECTRON MICROSCOPE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 35-37 manuscript received 12 Dec 77

BOCHAROV, YE. P. and SUDAKOV, S. A.

[Abstract] The video monitor is an inseparable part of an electron microscope operating in the scanning mode, since it permits visual monitoring of processes occurring when the electron probe interacts with the target. The information content of the object's image greatly determines the functional possibilities of the microscope which, in turn, is governed by the image's field and contrast resolution. This device uses a color CRT with color encoding to distinguish more subtle structures of the image; however the use of color images entails consideration of the eye's inherent resolution for fine details, their brightness, contrast and hue and tint. B/W and green

parts have the highest color resolution, while light blue items have the lowest. The subtle items of a color image are visually perceived much better in terms of brightness than in terms of color. As items of different color are reduced in size, these items seem to become grey in color. The number of distinguishable brightness gradations is affected by the degree of image noise: it is defined not only by its intensity but also by its spectral composition. 2 figures; references 8: 7 Russian, 1 Western.

USSR

UDC 535.411

AUTOMATIC ADJUSTMENT OF FOURIER SPECTROMETER WITH RAPID SCANNING

Leningrad OPTIMO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 55-58 manuscript received 14 Feb 78

SHAROV, YE. M. and ARKHIFOV, V. V.

[Abstract] The advantages of rapid scanning were the cause for the popular use of methods of Fourier spectrometry in various optical meters such as Fourier spectrometers and thickness gauges. But the increased sensitivity of the interferometer to external effects led to a loss in efficiency due to disadjustment of the optical circuit causing considerable problems in operation. There exist various methods to enhance interferometer stability: increased rigidity of construction and appropriate choice of materials, but these are not a panacea. There are automatic adjustment devices, but these involve additional optical elements requiring special complex electronics; in contrast to these, a new method requires no such additional optics nor electronics but does consider the distinctive features of construction and design of the rapid-scanning Fourier spectrometer. If the measuring interferometer does not contain a monochromatic emission reference channel (such as in the Digilab FTS-14), a signal may be received from an IR source which is also the illuminator in the Fourier spectrometer or from a blackbody simulator. 4 figures; references 9: 5 Russian, 4 Western.

STATE OF THE ART AND OUTLOOK FOR COMPUTER TECHNOLOGY IN QUANTOMETERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 65-70 manuscript received 6 Mar 78

LIFLYANDCHIK, B. I., ROMANOVA, V. D., STARTSEV, G. P. and TRILESNIK, I. I.

[Abstract] The use of computer facilities in multichannel spectrometers with a dispersing optical system is considered: in spectrometers with several parallel detectors each of which receives emission in a narrow spectral range. Most of these are multichannel photoelectric devices--quantometers with a photomultiplier detector system. Since in emission spectral analysis the link between emission intensity of spectral lines and the concentration of the test elements is generally nonlinear in nature and depends on many factors, the determination of the content of various elements is done in terms of graduated characteristics which are preconstructed according to the results of analysis of standard specimens of a known composition: each graduated characteristic encompasses a limited range of concentrations. The use of computers in spectrometers has reached a high level, enhancing speed, accuracy and reliability. There are two major trends of enhanced efficiency. One of these is the expansion of interconnections between complexes of spectral devices and complexes or networks of computers. The second and perhaps more important trend is improvement of computer software, especially design of algorithms which permit the use of more complex mathematical models and take into account the specifics of spectrometer operation with TV type detectors. Optoelectronic systems now require enhanced stability and accuracy plus flexibility of adjustment to meet the continuously expanding functions of industrial analysis and monitoring of production. 4 tables; references 52: 23 Russian, 29 Western.

DEVICE FOR RECORDING HOLOGRAMS IN THE ACCUMULATOR OF A PERMANENT HOLOGRAPHIC MEMORY

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 71-72 manuscript received 20 Jan 78

VALIS, A. S., KAUSHINIS, S. K., MALISHAUSKAS, M. A., CHAPLIKAS, P. P. and RAGUL'SKIS

[Abstract] There are two types of holographic optical arrangements for recording information: those in which the beam track geometry is altered when the data bank is changed and those with an unchanged reference beam

position. The latter are easy to realize because of their simplicity and the lack of optoelectrical components. The basic optical circuit of a permanent holographic device for data recording uses a stationary reference beam and mechanical movement of the recording medium, here a Mikrat-VRL type photographic plate 9 x 12 cm in size. Information is recorded as a grid containing 32 x 32 phase microholograms; raster spacing is 1.5 mm along one coordinate and 1.67 mm along the other. One microhologram has a size of 1.3 x 1.3 mm and contains 96 x 98 bits; the dimensions of the working region of the transparency are 19.2 x 19.6 mm. A phase mask is used to obtain high diffraction efficiency: it equalizes the intensity distribution of laser light in the focal plane of the lens. The photographic plate is moved to the required position semiautomatically. According to the transparency address entering from the reader, the signal shaper which controls the mechanical portion locates the appropriate hologram address upon instructions from the control panel. Exposure time is controlled by a recording control unit: the operator determines the optimum exposure according to laser beam power display readings. 4 figures; references 5: 4 Russian, 1 Western.

USSR

UDC 621.383.8

STUDY OF DARK CURRENT OF MICROCHANNEL PLATES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 72-74 manuscript received 1 Mar 78

PLETNEVA, N. I., MEL'NIKOVA, M. M. and ZATTAROV, D. K.

[Abstract:] The use of microchannel plates as an amplification stage in image converter tubes makes it possible to produce devices with several advantages over image converters using other methods to amplify image brightness: significant reduction of converter dimensions and reduced power supply voltage, possibility of control of gain within wide limits and protection against local noise. But the use of microchannel plates may reduce threshold sensitivity because of plate dark current, i.e. and output current when there is no signal at the plate input. The magnitude of this dark current also determines the background that the plate introduces into the device, regardless of other noise sources associated with signal amplification. Dark current was studied by drawing hollow glass tubes in a disassembled mockup of an image converter. The value of equivalent input dark current is the ratio of microchannel plate dark current to the plate's gain. To measure gain, a photoemission layer was applied on the cathode glass of the image converter mockup. For most plates manufactured by drawing hollow glass tubes, the density of dark current is 10^{-14} - 10^{-13} A/cm²: with gain of 10^4 , equivalent input dark current is 10^{-18} - 10^{-17} A/cm²: the threshold sensitivity of devices with microchannel plates should not be reduced because of plate dark current. 3 figures; references 7: 4 Russian, 3 Western.

INFRARED SPECTROSCOPY AND CATHODOLUMINESCENCE OF SYNTHETIC SEMICONDUCTOR DIAMONDS

Kiev DOPOVIDI AKADEMIYI NAUK ULRAYINS'KOYI RSR, SERIYA A FIZYKO-MATEMATYCHNI TA TEKHNICHNI NAUKY in Ukrainian No 5, May 5 pp 365-369 manuscript received 13 Jul 78

MALOHOLOVETS', V. H., VYSHNEVS'KYY, A. S. and SAMOYLOVYCH, M. I., Institute of Superhard Materials, Academy of Sciences of the Ukrainian SSR

[Abstract] A study of synthetic semiconductor type-IIb diamonds was made by the methods of infrared spectroscopy and cathodoluminescence. The diamond crystals for this analysis had been grown from a Ni-Mn-C doped with B, Ti, or both, and from a Fe-Mg-Zn-C system. The bands in the absorption spectrum have been determined for $\langle 111 \rangle$ and $\langle 100 \rangle$ growth pyramids, donor nitrogen being adsorbed mainly by the former and acceptor boron being adsorbed mainly by the latter, both forming N-B impurity D centers. The article was presented by academician O. S. Povarennikh (Academy of Sciences of the Ukrainian SSR). Figures 3; tables 1; references 9: 4 Russian, 5 Western.

USSR

UDC 532.527+532.517.4

STRUCTURE OF TURBULENCE NEAR THE CORES OF AN ANNULAR VORTEX

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 245 No 6, 21 Apr 79 pp 1325-1328 manuscript received 8 Dec 78

VLADIMIROV, V. A. and TARASOV, V. F., Institute of Hydrodynamics, Siberian Division of the USSR Academy of Sciences, Novosibirsk

[Abstract] A study of the turbulence structure was made with annular vortices generated by a plunger expelling a fixed volume of fluid through a tube. Water served as the test fluid, with the Reynolds number within the $(2-4) \cdot 10^4$ range. In the first test the fluid was dyed prior to expulsion, in the second test an initially "clean" vortex was passed through a layer of dyed fluid, in the third test the inside surface of the tube wall was coated with a dye near the discharge end. Motion pictures of the flow pattern show that the threads of a vortex helix were retained throughout, with no dye and thus no fluid transported radially across the vortex core. There exists, therefore, a laminar region within such a vortex where no turbulent mixing occurs. This phenomenon is explained by elasticity of rotating streams and on the basis of a 2-step profile of turbulent viscosity. Turbulent stresses in the adjoining region can be calculated from force and energy relations, taking into account nonlinear processes characterized by the Rossby number. A close agreement with experimental data can be obtained by appropriate smoothing of the viscosity profile. The authors thank B. A. Lavgovtsov for the attentiveness. The article was presented by M. A. Laverent'yev on 10 Nov 78. Figures 4; references 11: 3 Russian, 1 German, 7 Western.

USSR

UDC 532.582.5.001.5

PARAMETERS OF THREE-DIMENSIONAL FLOW AROUND A HYDROFOIL IN THE NEIGHBORHOOD OF THE FREE SURFACE OF A PONDERABLE FLUID

Moscow IZV AN SSSR MEKHANIKA ZHIDKOSTI I GAZA in Russian No 2, 79 pp 54-62
manuscript received 13 Oct 77

LUKASHEVICH, A. B., Leningrad

[Abstract] The flow of a ponderable fluid with a free surface around a hydrofoil of finite span is examined in a coordinate system whose origin is placed at the level of the unperturbed free surface above the hydrofoil. The ponderability of the fluid is taken into account with the aid of the method of singularities, which represents the effect of the free surface of water by an infinite layer of sources, with the hydrofoil and the zone of its wake being represented by a combination of singularities--eddies, sources, and dipoles. A system of integral equations for the determination of intensities of these sources is derived. In principle, certain solutions of this system serve to obtain data on both the hydrodynamic characteristics of the hydrofoil and the wave motion of the fluid. The presented numerical method for the solution of the resultant integral equation, which fundamentally is independent of the form of the mathematical model of the hydrofoil (lifting line, eddy surface, distribution of singularities over hydrofoil contour), is sufficiently effective and serves to obtain final results for hydrofoils of any shape. References 10: 9 Russian, 1 Western.

USSR

UDC 533.69.01 533.662.013

A HYPERSONIC VISCOUS SHOCK LAYER ON INFINITE-SPAN SWEEPBACK AIRFOILS WITH AIR FLOWING AROUND THEM AT ANGLE OF ATTACK

Moscow IZV AN SSSR MEKHANIKA ZHIDKOSTI I GAZA in Russian No 2, 79 pp 91-102
manuscript received 18 Apr 78

BRYKINA, I. G. and GERSHBEYN, E. A., Moscow

[Abstract] The flow of a viscous compressible gas in the hypersonic shock layer around infinite-span sweptback airfoils with a blunted leading edge at various angles of attack is considered. Equations of the hypersonic viscous shock layer with modified Rankine-Hugoniot relations applied to the shock wave and with boundary conditions at the airfoil surface allowing for slip and temperature discontinuity are solved by the method of successive approximation serving to derive both an analytic solution for the first approximations and an exact numerical solution when implemented with the aid

of a computer. In addition to the analytic solution of the problem, formulas for coefficients of friction and heat transfer at the airfoil surface are presented, as are formulas for the velocity and temperature profiles across the shock layer. Comparison of the analytic and numerical solutions reveals satisfactory accuracy of the analytic solution in the presence of not too high Reynolds numbers ($\text{Re} \leq 50$). The approximate analytic formulas are used to calculate flow in the hypersonic viscous shock layer in the neighborhood of parabolic, hyperbolic, circular, and elliptical cylinders positioned at angles of slip and attack to the incident flow. Figures 5; references 13: 9 Russian, 4 Western.

USSR

UDC 533.9.082.76

THEORY OF COOLED ELECTRICAL PROBES IN DENSE PLASMA. EFFECT OF THERMAL DIFFUSION

Moscow IZV AN SSSR MEKHANIKA ZHIDKOSTI I GAZA in Russian No 2, 79 pp 103-112 manuscript received 26 Jan 78

PANKRAT'YEVA, I. L. and POLYANSKIY, V. A., Moscow

[Abstract] The problem of a spherical probe placed in sufficiently dense weakly ionized quiescent three-component plasma is considered. It is assumed that the three components of the plasma are: neutral particles, positive ions of one kind, and electrons. Only the case in which the densities of the charged components are much smaller than the density of the neutral component is considered. It is also assumed that the dimensions of the probe (radius of the sphere) markedly exceed the mean effective free path of charged particles, thus assuring the investigation of the problem of the distribution of plasma parameters in the neighborhood of a probe (a conducting sphere to which electrical potential of varying magnitude can be supplied) from the standpoint of continuum mechanics. Electrical probes are used to measure local plasma parameters--the electrical potential of plasma, the density of charged particles, and the temperature of electrons. Formulas for electrical current densities of the plasma components are derived with allowance for mass transport due to thermal diffusion and a new numerical method serving to obtain a solution of the problem for a broad range of determining parameters is obtained. The effect of probe temperature, transport coefficients, and other parameters on the behavior of the current-voltage characteristic is examined. Figures 5; references 9: 7 Russian, 2 Western.

USSR

UDC 534.222.2

INTERACTION OF MODERATE-INTENSITY SHOCK WAVES WITH A CYLINDER

Moscow IZV AN SSSR MEKHANIKA ZHIDKOSTI I GAZA No 2, 79 pp 113-119 manuscript received 16 Jan 78

LYAKHOV, V. N., Moscow

[Abstract] The incidence of a plane shock wave on an infinite circular solid cylinder whose axis is parallel to the wavefront is examined. The attendant load and force exerted on the cylinder are computed. The shock wave considered is of moderate intensity, that is, the pressure ratio at its front is $\sim 1.01:5$. The process is analyzed in a mathematical model with the aid of the finite-difference method with second-order accuracy. Systematic calculations within the above intensity range are performed with respect to an adiabatic exponent of 1.4, thus serving to derive detailed characteristics of both the unsteady stage of the process and the stage subsequent to it. It is shown that calculations based on the finite-difference method are accurate within 10-20% as regards pressures. The computational errors due to disregarding boundary-layer effect and the order of approximation of differential equations by difference equations as well as the relative size of the cells of the computational grid are estimated. Figures 4; references 12: 11 Russian, 1 Western.

USSR

UDC 621.165.533.601

THE FLOW OF SUPERHEATED AND MOIST STEAM IN THE REGULATING VALVES OF STEAM TURBINES

Moscow TEPLOENERGETIKA in Russian No 4, Apr 79 pp 27-31

DEYCH, M. YE., doctor of technical sciences, SAPUNOV, O. G., engineer, SHANIN, V. K., candidate of technical sciences, Moscow Institute of Power Engineering

[Abstract] A study is made of the results of structural investigation of the flow through a valve when it is opened to various degrees, the pressure drop and the moisture content. Experiments performed showed that the flow of slightly superheated and wet steam from regulating valves has certain significant peculiarities: as the moisture content increases, the critical pressure ratio, which depends on the initial moisture content and degree of opening of the valve, decreases; restoration of pressure in the diffusers

of the valves decreases with increasing moisture content; the pressure pulsation characteristics beyond the valve change quite sharply upon transition from superheated to dry, saturated and wet steam (amplitudes of pulsations increase by 30-50%, while frequency of pulsations decreases to a very dangerous level--about 500-600 Hz). Figures 6; references 3 (Russian).

USSR

UDC 621.165

INFLUENCE OF TURBULENCE OF THE INCIDENT STREAM ON LOCAL HEAT TRANSFER IN TURBINE CASCADES

Moscow TEPLOENERGETIKA in Russian No 4, Apr 79 pp 31-36

ZYSINA-MOLOZHEN, L. M., doctor of technical sciences, and ROOST, E. G., engineer, Production Association of Central Institute for Boilers and Turbines; Plant and Higher Technical School of Leningrad Metals Plant

[Abstract] Studies were performed on a static test stand at the Central Boiler and Turbine Institute. Two sets of cylindrical guide vanes were tested, each consisting of five vanes with the thickened leading edge characteristic for cooled vanes. Only longitudinal velocity pulsations were measured in the experiments. Recommendations were developed allowing more reliable determination of the heat transfer to the guide vanes in a turbine. This allows more precise determination of their thermal and stress states and, consequently, facilitates an increase in the reliability of the turbines. Furthermore, knowledge of the local heat transfer allows efficient distribution of the coolant over the inlet contour of the cooled blades in high-temperature turbines, increasing economy. Figures 8; references 7: 6 Russian, 1 Western.

NUMERICAL INVESTIGATION OF MIXED DISCONTINUOUS TWO-PHASE FLOW IN TURBOMACHINE CASCADES

Moscow IZV AN SSSR, ENERGETIKA I TRANSPORT in Russian No 2, 1979 pp 135-142
manuscript received 11 Jul 78

DEYCH, M. YE., SALTANOV, G. A. and SIVOBOROD, V. A., Moscow

[Abstract] The development of wet-steam turbines necessitates research into the gas dynamics of two-phase media, since the effect of liquid-phase particles on steam parameters has been relatively uninvestigated. In this connection, a method for numerical analysis of the flow of wet steam through flat blade cascades with allowance for mechanical and thermal interaction between the phases is presented. A system of differential equations describing planar unsteady flow of gas with particles is derived and an algorithm for the numerical integration of the resulting difference equations is constructed. The resultant separation, discharge rate, and energy-balance characteristics make it possible through numerical experiment to optimize blade cascades operating on wet steam so as to select expedient values of relative blade pitch, blade camber angle, and blade shape. The calculations are performed on assuming absence of phase transitions. Figures 5; references 23: 22 Russian, 1 Western.

USSR

INTERNAL CONTACT INTERACTION BETWEEN A DISK AND A RING REINFORCED BY A THIN ANNULAR COATING ON THE PERIPHERY OF AN ORIFICE

Yerevan IZV AN ARM SSR, MEKHANIKA in Russian No 1, 1979 pp 3-17 manuscript received 24 Apr 78

TOROSYAN, F. S., Leninakan Affiliate of the Yerevan Polytechnic Institute imeni K. Marx

[Abstract] While contact problems of the interaction between a disk and an infinite plate containing a circular orifice of similar radius have been fairly well investigated, problems of the same kind in which a circular ring is considered in lieu of the infinite plate with circular orifice have remained largely uninvestigated. In this connection, the author considers the contact problem of the pressure exerted by a flexible disk on the inner contour of a flexible ring when that contour is reinforced by a thin flexible annular coating welded or cemented to it. It is assumed that the outer contour of the ring is rigidly attached. The physical model of the reinforcing flexible coating is taken to be the model of the stressed state of thin cylindrical shells based on the known Kirchhoff-Love hypotheses. The disk is inserted in the ring and subjected to compressive and torsional stresses. The solution of the investigated problem reduces to the solution of a Fredholm integral equation of the first kind. With the aid of the apparatus of orthogonal Jacobi polynomials an effective solution of the resolving equation is derived. Two other particular cases are considered: 1) the flexural rigidity of the reinforcing coating is disregarded; 2) the reinforcing coating is absent. Numerical analysis is performed with the aid of a Nairi-2 computer. Figures 3; references 14: all Russian.

USSR

DYNAMIC STABILITY OF A CONDUCTING SPHERICAL SHELL IN A MAGNETIC FIELD

Yerevan IZV AN ARM SSR, MEKHANIKA in Russian No 1, 1979 pp 18-25 manuscript received 6 Sep 77

MKRTCHYAN, P. A., Institute of Mechanics, ARM SSR Academy of Sciences

[Abstract] The dynamic stability of a closed spherical shell of constant thickness, made of a material of finite electrical conductivity and placed in a radial inhomogeneous magnetic field is considered. A linearized system of singular integro-differential equations of stability of the spherical shell is derived on the basis of the following assumptions: 1) magnetoelasticity of thin bodies such as the shell; 2) applicability of Maxwell's equations for the

vacuum with respect to the ambient medium; 3) disregard of the effect of displacement currents on stability characteristics. The derived equations are used to examine the problem of the parametric vibrations of the shell in a radial magnetic field. An equation for determining the critical frequencies of the principal parametric resonance is obtained. The effect of specified magnetic field intensities on the critical frequencies in the dynamic instability domain is considered. Figures 3; references 10: all Russian.

USSR

STABILITY OF A CURRENT-CARRYING SHELL IN AN EXTERNAL MAGNETIC FIELD

Yerevan IZV AN ARM SSR, MEKhanika in Russian No 1, 1979 pp 26-35 manuscript received 5 Mar 78

KAZARYAN, K. B., Institute of Mechanics, Armenian SSR Academy of Sciences

[Abstract] The problem of the stability of a current-carrying shell of finite length with electrical current flowing along its generatrix is considered on the basis of equations of the engineering theory of thin shells. The shell is exposed to an external longitudinal magnetic field parallel to the current. The critical densities of electrical current and intensities of external magnetic field at which the shell loses its stability are determined, on assuming that the material of the shell is isotropic, lacks magnetic properties, and is a conductor of electrical current. Such a stability problem belongs in the class of non-self-adjoint boundary-value problems and is solved by the Bubnov-Galerkin variational method. It is shown that the external magnetic field parallel to the shell's current reduces the shell's stability domain. This finding is corroborated by qualitative analysis of shell stability. A table of critical current densities and magnetic field intensities is provided. Figures 1; references 9: 8 Russian, 1 Western.

ON THE EFFICIENCY OF FLEXIBLE GEAR RING DRIVES WITH A LOW GEAR RATIO

Moscow VESTNIK MASHINOSTROYENIYE in Russian No 4, Apr 79 pp 17-18

FINOGENOV, V. A. and TROSTIN, V. I., candidates of engineering sciences

[Abstract] A low gear ratio can be obtained by using a strain-wave gear coupling where the number of teeth in the rigid and flexible gear rings are different, however, this makes it necessary to compensate for increased deformation of the flexible ring under heavy loads. Numerous experiments were performed to determine the optimum parameters using a flexible ring with a diameter of 200 mm and a length of 200 mm driven by both disk and cam type strain-wave generators. The gear ratio ranged from 35.5 to 62 and the rotational speed of the driving generator from 250 to 1,500 r.p.m. It was determined that wide variations in the structural parameters had only a slight influence on the efficiency with the greatest efficiency drop amounting to about 5 percent. The highest efficiency achieved was 87 percent when the test reduction gear sustained a load of about 1,250 N · m with a PT-250M brake. The research showed that this transmission has a shorter service life when the gear ratio is less than 70, and the authors call for further studies to find ways of increasing their service life. Figures 3; references: 5 Russian.

THE CRITICAL VELOCITIES OF THE FLEXURE OSCILLATIONS OF ROTORS IN GAS DYNAMIC BEARINGS ON ELASTIC VIBRATIONAL DAMPING SUPPORTS

Moscow VESTNIK MASHINOSTROYENIYE in Russian No 4, Apr 79 pp 31-35

POSPELOV, G. A., doctor of engineering sciences

[Abstract] A procedure is given for calculating the critical values of the rotational speed of rotors running in gas dynamic bearings, which takes into account the dynamic forces of the lubricating layer. A mathematical model is set up for the synchronous vortex motion of the shaft and damping support bearing, where the values of the stiffness and damping coefficients are averaged over a vortex motion cycle. The equations derived are discussed as applied to two cases: a steel shaft supported at both ends having a length of 0.8 m and a diameter of 0.05 m; a centrifugal oxygen compressor rotor for developing a pressure of 0.65 MPa at a rate of 100 m³/min, where the oxygen lubricated supports were 1.34 m apart. Experiments show that the transition of the rotors through the critical angular frequencies of the flexure oscillations in gas static and dynamic bearings is easily passed since these transitions are realized at low angular velocities. The results are also applicable to bearings with oil lubrication. Figures 4; references: 7 Russian.

NONLINEAR DEFORMATION OF CYLINDRICAL SHELLS WITH AN ELLIPTICAL CROSS SECTION UNDER A UNIFORM EXTERNAL PRESSURE LOAD

Moscow IZV AN SSSR, MEKHANIKA TVERDOGO TELA in Russian No 2, 79 pp 117-122
manuscript received 28 Jun 78

ANDREYEV, L. V., ANDRIANOV, I. V., KUCHERENKO, V. M., LEBEDEV, A. G. and
OBODAN, N. I., Dnepropetrovsk

[Abstract] The known formulas for the stability of cylindrical shells with elliptical cross section under an external pressure are based on the assumption of linearity of the torqued or untorqued precritical state, and the results thus obtained apply only to nearly circular cross sections. The behavior of strongly elliptical shells, on the other hand, has been relatively uninvestigated. To fill this gap on proceeding from the assumption of nonlinearity, a system of ordinary nonlinear differential equations is derived and combined with boundary conditions to form a one-dimensional boundary value problem solved numerically through conversion to the Cauchy problem, for the case of successively increasing values of load on the shell. These calculations reveal important features of behavior of the shells considered: the critical load on an ideal shell can be determined with respect to an extremal point of the load versus maximum flexure diagram, and there exist bifurcation points located in the neighborhood of that extremal point and shifting their position depending on the geometrical parameters of the shell. The theoretical findings agree with the findings of experiments performed on six series of Kh18N9M sheet-steel shells (55 specimens) differing in material and rated thickness and length, which were subjected to external pressure by evacuating the air from their interior. Figures 5; references 8: 5 Russian, 3 Western.

USSR

UDC 539.3:534.1

CONSTRUCTION OF SOLUTIONS OF EQUATIONS OF THE FREE VIBRATIONS OF A NONCIRCULAR CYLINDRICAL SHELL

Moscow IZV AN SSSR, MEKHANIKA TVERDOGO TELA in Russian No 2, 1979 pp 123-131
manuscript received 20 Feb 78

BERGMAN, R. M. and LOBACHINSKIY, L. A., Baku

[Abstract] The method of asymptotic integration of differential equations is used to construct solutions of equations of the free vibrations of a non-circular cylindrical shell freely supported on curvilinear edges; these solutions display considerable variability in the direction of both the generatrix and the directrix. Qualitative features of the obtained solutions are analyzed. Since the variability of the curvature of a cylindrical shell markedly affects the integrals of quasilateral vibrations, the construction of precisely these integrals is considered: approximation equations of these integrals are derived from a dynamic analogue of equations of stressed states with a high variability index. Qualitative features of the obtained solutions are analyzed. The case of the presence of a turning point on the integration segment is considered and a complete ensemble of integrals for the solution of the given boundary-value problems is presented. References 5 (Russian).

USSR

UDC 539.3:534.1

BUCKLING OF A STRETCHED THIN PLATE WITH A CURVILINEAR HOLE

Moscow IZV AN SSSR, MEKHANIKA TVERDOGO TELA in Russian No 2, 79 pp 163-168
manuscript received 29 Jan 77

GUZ', A. N., KULIYEV, G. G. and ZEYNALOV, N. K., Kiev Baku

[Abstract] Solutions of problems of the elastic equilibrium of an unbounded pierced thin plate under the action of a homogeneous force field at "infinity" show that regions of compressive stresses arise around the hole in the plate. The intensity of these stresses is a function of the external load and the shape of the hole. Hence, the plate may buckle in the neighborhood of the hole once certain values of the external load are reached and given a certain size ratio of the hole to the plate thickness. Since the shape of the hole markedly affects the stress distribution in the plate, it was of interest to investigate buckling in the neighborhood of noncircular holes. An unbounded thin plate with a noncircular hole is considered; the edges of the hole are not subjected to external pressure. The material of the plate is assumed to be elastic and isotropic. Stability is investigated by the static method

from the standpoint of a Karman type theory. Variational equations of stability are derived in cartesian and curvilinear coordinates. Uniaxial tensile stress on a thin plate weakened by an elliptical hole is considered. The suitability of the variational method for investigating buckling in such plates is demonstrated. In the case of the application of uniaxial tensile stress to a plate with a curvilinear hole the critical load is higher than for a plate with a circular hole. Changing the orientations of noncircular holes can markedly enhance plate stability under the same external load. References 13: 10 Russian, 3 Western.

USSR

UDC 621.822.5.534.1

THE AXIAL OSCILLATIONS OF A ROTOR IN A TWO-SIDED GASDYNAMIC THRUST BEARING WITH SPIRAL GROOVES

Moscow VESTNIK MASHINOSTROYENIYE in Russian No 4, Apr 79 pp 38-41

AGISHEV, G. G., candidate of mathematical sciences

[Abstract] The nonlinear free and forced oscillations of a rotor supported on both sides by gasdynamic thrust bearings with spiral grooves are analyzed. The grooves are logarithmic spirals and have a constant relative width. Analytical expressions are derived for the forced and free oscillations and applied to the example of a 300 g rotor supported on both sides. The rigidity and damping properties of a specific gas bearing depend not only on its working conditions and the frequency of the oscillations of the body supporting it, but also on the amplitude of these oscillations. Figures 4; references 4: 3 Russian, 1 Western.

USSR

UDC 620.179.1

MECHANIZATION OF NONDESTRUCTIVE TESTING METHODS IN POWER MACHINERY PLANTS

Moscow ENERGOMASHINOSTROYENIYE in Russian No 2, Feb 79 pp 23-26

DOMASHEVSKIY, B. N., engineer and ROMANENKO, YU. F., engineer

[Abstract] A report on various mechanized facilities for nondestructive testing: an installation for TV radiographic quality control of welds to depths of up to 25 mm, a complex of facilities for radiation inspection of precision castings for turbine blades, the SGD-2 gamma flaw detector for checking welds in curved tubes, the Don-2 unit for ultrasonic checking for cracks and stratifications in large-diameter pipes, an ultrasonic contact echo flaw detector for checking flange bolts, special ferroprobe transducers for indication of the magnetic field of flaws, the Magneton-4 for semiautomatic inspection of gas-tight panels and the Radian facility for semiautomatic quality control of the surface of the heat-affected zone in thick-walled steel welds. Figures 5; references 6 (Russian).

USSR

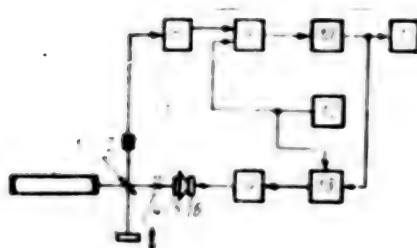
UDC 531.853.4:533.6.01

A SUBMILLIMETER COMPENSATION INTERFEROMETER FOR DIAGNOSING AN OPTICALLY DENSE PLASMA

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, Feb 79 pp 18-19

KUTOVOY, V. D., PETROV, G. D., SAMARSKIY, P. A. and TREGUBOV, S. I.

[Abstract] The paper describes a submillimeter version of an interferometer of compensation type with accuracy that is practically independent of the size of losses in the measurement channel and fluctuations of the power of the source of radiation. The output signal of the instrument correlates unambiguously with the phase advance measured over a range of more than 12π radians. The instrument is shown schematically in the diagram. A cw HCN laser 1 sends emission to a beam splitter 2 and the beams are reflected from mirrors 3 and 5. Mirror 3 can be shifted by a micrometer movement, while mirror 5 is moved by dynamic head 6. Attenuator 4 in the measurement arm simulates attenuation of radiation in the investigated medium. Emission is recorded by pyrometric sensor 7, which puts out a signal to selective amplifier 8 and synchronous detector 9. A signal from a-f oscillator 12 is sent to synchronous detector 9 and to adder circuit 13. The DC output voltage of the synchronous detector goes through amplifier 10 and is recorded by voltmeter 11 and is also sent to adder 13 where it is combined with the AC voltage of oscillator 12. The output signal shifts the coil of dynamic head 6. Figures 3; references 6: 5 Russian, 1 Western.



USSR

UDC 621.3.013.62-503.51

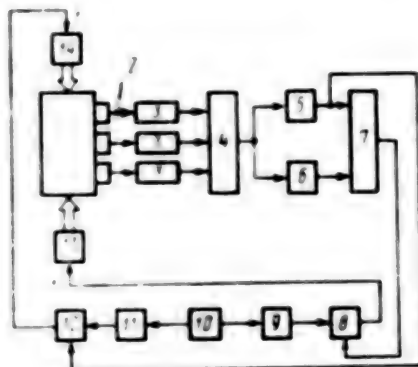
A MULTICHANNEL FACILITY FOR STABILIZING VIBRATION AT PARAMETRIC RESONANCES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, Feb 79 p 31

RYGALIN, V. G.

[Abstract] The article describes a multichannel facility that detects parametric resonances and stabilizes vibration parameters on a predetermined level. The device is shown schematically in the diagram. Fastened to the object 1 are vibration transducers 2 that are connected through matching amplifiers 3 to a multichannel vibration-measuring instrument 4 that isolates the maximum signal from all measured vibration accelerations. Connected to the output of meter 4 are adjustable sum and difference frequency filters 5 and 6 with outputs connected to the inputs of comparator 7. Vibrators 13 and 14 act on the study object. One (say 13) has a much higher output power than the other. Frequency f_2 of vibrator 14 is set by oscillator 10 through frequency divider 11 so that it is lower than the frequency f_1 of vibrator 13. The combined action of the vibrators sets up parametric vibrations in the various elements of the object on sum and difference frequencies because the stiffness of the elements becomes a function of the frequency of the stronger vibrator. The phases of the stimulated vibrations are matched by phase shifter 9, resulting in parametric resonances on the sum and difference frequencies. The signal from the output of sum frequency filter 5 acts on controllable amplifier 12 to maintain the amplification of vibrator 14 proportional to a predetermined frequency ratio and thus stabilize the level of parametric vibrations. Parametric resonance causes a mismatch signal to appear at the output of the comparator 7, proportional to the difference between the sum and difference frequencies. This signal acts on controllable amplifier 8 to reduce the level of excitation of main vibrator 13 and eliminate self-excitation, keeping the vibrations of the object stabilized on a predetermined level. The facility has a frequency range of

2-10 kHz with 10 measurement channels. Accelerations can be measured over a range of 1-5000 m/s² with measurement error within 2.5%. Figure 1; references 2 (Russian).



USSR

UDC 531.71.089.6.085

NEW INSTRUMENTS DEVELOPED AT THE UKRAINIAN REPUBLIC CENTER FOR STANDARDIZATION AND METROLOGY TO MEASURE LINEAR AND ANGULAR QUANTITIES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 2, Feb 79 pp 68-71

IGNAT'YEV, YE. B., LYUBARSKIY, A. YA., NECHIPORENKO, L. P. and SPITKOVSKIY, A. I.

[Abstract] Brief descriptions are given for precision instruments that measure linear and angular quantities recently developed at the Ukrainian Republic Center for Standardization and Metrology. An updated version of the FIK-1 attachment installed on a universal measurement microscope combines the advantages of the direct method of length measurement with the sensitivity of an electronic contact indicator. The SIL-2 universal instrument is designed for determining the measurement force on micrometers, measurement heads, dial indicators, contact interferometers and other such devices. The UPU-2 device for checking try squares up to 600 mm in height certifies first-class and second-class squares type UP and USh. Figures 4; references 4 (Russian).

INVESTIGATION OF THE ABSORPTIVE-EMITTING CHARACTERISTICS OF AN IDEAL SELECTIVE SURFACE

Tashkent GELIOTEKHNIKA in Russian No 2, 1979 pp 55-62 manuscript received 4 Jan 78

KUDRIN, O. I. and ABDURAKHMANOV, A., Moscow

[Abstract] The possibility and advantages of using spectrally selective surfaces of high-temperature heating by means of solar irradiation has become very topical, but insufficient attention has been given to the subject. Basic concepts about an ideal selective surface, maximum possible heating temperature and the use of the second law of thermodynamics and Kirchhoff's law in particular need refinement. Many questions can be answered by examining the best values of absorptive and emissive characteristics attributed to the perfect selective surface. Solar emission can be well approximated as emission of an ideal black body with a temperature of 5800 K whose greatest intensity is in the spectral range 0.1-2.5 microns where 97 % of all its emitted energy is concentrated. With the absence of concentration of emission at the level of the Earth's orbit, a selectivity parameter very close to 46,000 is possible. 4 figures; references 6: 4 Russian, 2 Western.

AIR TEMPERATURE REGULATOR FOR HIGH-OHMIC MEASUREMENT OF ELECTRICAL RESISTANCE

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 4, 1979 pp 44-45

SHIDORENKO, V. N., PAVLENKO, YE. S., KLIBANOV, L. I. and YUDKOVICH, I. SH.

[Abstract] Testing of precision resistance devices depends on the accuracy of maintenance of ambient temperature. Temperature control device usually heat up their relays and repeated switching of the compressor causes overheating: the new device uses contactless relays. The temperature regulator controls a heating element, while the cooling unit is continuously operating. To maintain stable temperature, the temperature regulator chamber contains a fan. Required temperature conditions are created by combined or separate operation of cooling unit and/or heater. Tests showed temperature error to be no greater than $\pm 0.05^{\circ}\text{C}$. Temperature gradient in the chamber at 20°C does not exceed $\pm 0.05^{\circ}\text{C/m}$ at full load (6 resistance coils, e.g. type R4030). Performance of the devices meets the appropriate State Standards. 1 figures; references: 3 Russian.

STABILIZED-OUTPUT D. C. AMPLIFIER

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 4, 1979 pp 45-46

SEBKO, S. YE. and KLIMASHIN, V. P.

[Abstract] D. C. amplifiers with very small temperature drift of the constant component and initial constant zero displacement are often required. Some d.c. amplifiers use electrometer tubes and dynamic capacitors--the new device feeds a d.c. compensating signal periodically modulated by a solid-state flip-flop or modulator. Circuit is hard to realize due to errors arising in the decision circuit and instability of parameters in the feedback circuit during the compensation cycle. The d.c. amplifier has the following specifications: gain 2000 ± 10 o/o; suppression of cophased signals and interference, at least 40 dB; at least 1 megohm input impedance; maximum output signal at least 5.7 VAC; output resistance 330 ohms; temperature drift of constant level does not exceed 0.05 microvolts/K; operating temperature range $\pm 45^{\circ}\text{C}$. The circuit is driven by two stabilized d.c. sources $\pm 12.6\text{V}$; required current is not more than $45\text{ mA} \pm 10$ o/o. The circuit is assembled on a 160×80 mm printed circuit board made of dual-face metallized fiberglass laminate. 1 figure.

STABILIZED SINE-WAVE GENERATOR

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 4, 1979 pp 46-47

SHABALIN, L. L. and BAKLANOVA, L. N.

[Abstract] Four-channel converters are used in shipbuilding to measure pressures, various deformations and vibrations--they are designed to power strain gauges at 12VAC, 2500 Hz. In measuring vibrations of a ship's hull, for example, a large number of strain gauges and power sources are required: as a result in decoding the parameters, there is a frequency beat which distorts the readouts. Frequency balancing and stabilization is provided by a sine-wave generator designed to power 50 strain gauges: output voltage $18\text{V} \pm 1$ o/o; nonlinear distortion not more than 3 o/o; frequency instability 0.005 o/o; output power $2\text{W} \pm 10$ o/o; operating temperatures $5-40^{\circ}\text{C}$. A 2T312 transistor is used as the master oscillator in a Hartley induction circuit. Use of an Alsiifer alloy transformer core made it possible to achieve stability of about 10^{-4} . The transformer is wound with PEVO.23 wire: number of turns,

wire: number of turns, 263,547, 60 and 60, respectively. The d.c. amplifier is designed using an MP42B transistor. The comparison circuit consists of a reference voltage source containing a KS139 stabilatron. 1 figure; references: 1 Russian.

USSR

UDC 621.317.738

NEW METER FOR DIELECTRIC PARAMETERS OF CONDUCTIVE SUBSTANCES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 4, 1979 pp 47-49

PODGORNIY, YU. V. and TERLETSKAYA, L. A.

[Abstract] There have been no commercially produced meters to measure the frequency range of 0.1-10 megahertz of dielectric constant (permittivity) of substances with high specific conductivity. The main stumbling blocks in the development of a permittivity meter are: sharp drop in meter circuit sensitivity when the loss tangent of the test substance is greater than 2; and invariance of permittivity meter when measuring permittivity versus conductivity. The Sh2-3 permittivity meter operates by using the resonance effect in a passive oscillation loop with parametric modulation, which loads an rf oscillator across a coupling resistor. Replacing the capacitive cell is a voltage-controlled solid-state capacitor (a group of counter-connected D901 or KV104 varicaps). When the cell is connected to the passive oscillation loop, the varicaps are switched from the meter loop to the reference oscillator. The permittivity meter contains a TZhD-71 temperature control device. It can measure ferroelectrics in the temperature range -100 to +600°C. The range of measured capacitances is 5000 picofarads. 3 figures; references: 4 Russian.

USSR

UDC 621.384.326

EFFECT OF OPTICAL SYSTEM ABERRATIONS ON BASIC PARAMETERS OF AN INFRARED TV RECEIVER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978 pp 3-5 manuscript received 16 Nov 77

UKHOV, B. V., KLOCHKOVA, V. G., KRASNIKOV, D. N. and BENZA, S. M.

[Abstract] It is assumed that an infrared TV systems scans two infinitely long strips perpendicular to the direction of line scanning: the width of

these strips and their interval is equal to the instantaneous angle of vision of the TV system. In an actual optical system, aberrations and diffraction scattering cause image washout. The scattering function was approximated by a gaussian function, which is valid with a sufficient degree of accuracy for many actual optical systems. The sensing element of the photodetector scans the image by traveling along the x axis. Magnitude of the signal at the output of a zero-lag photodetector is described by a series of integral equations. The signal from the photodetector output is transmitted to the amplifier input; the amplifier has a finite bandpass. The rate of scanning is assumed to be great and thus the effect of photodetector noise with a spectral density of $1/f$ can be ignored. The output signal was calculated using a Minsk-32 computer. Equations cited may serve as the basis for quantitative evaluations of the energy and angular resolutions of an infrared television receiver if the scattering circle of the optical system is widely fluctuating. References 2: Russian.

USSR

UDC 621.384.32

EVALUATION OF EFFECTIVENESS OF MULTISPECTRAL OPTOELECTRONIC SYSTEMS WITH COLOR IMAGE DISPLAY

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978 pp 5-8 manuscript received 9 Nov 77

GALIAKHEROV, D. SH., DOROFYEV, V. A. and OVSYANNIKOV, V. A.

[Abstract] In order to enhance decodability, recent optoelectronic systems have used the high color-distinguishing ability of the human eye. In such systems, signals of three channels recording the emission of objects in three spectral ranges enter inputs of three additive color-mixing displays. By altering the characteristics of emission of the recorded objects within a wide range of the spectrum, there is a change in both brightness and color, making it possible to detect temperature changes in the object with much greater sensitivity than is possible using B/W displays. Methods of approximate calculation are presented and these characteristics are evaluated for a typical system of recording thermal emission of objects. Two channels operating in different spectral ranges were found to be adequate: the presence of a third channel does not increase the probability of detection of temperature changes, but may be useful to expand the color range of images. Each value of blackbody temperature corresponds to some relationship of signal addition weights in various spectral channels to assure maximum probability of detection, but substantive deviation from optimum has a negligible effect on probability. References 9: 6 Russian, 3 Western.

ANALYSIS OF METROLOGIC POSSIBILITIES OF A COHERENT-OPTICS METHOD OF CHECKING THE SHAPE OF COMPLEX SURFACES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 8-10 manuscript received 17 Feb 78

KUDRYAVTSEV, V. A., SHANIN, V. I. and SHAPOV, V. S.

[Abstract] Earlier studies investigated an optical method of automatically checking the shape of complex surfaces based on three-dimensional encoding of information and optical matched filtration. Metrologic possibilities of the method are analyzed and requirements are established for positioning articles in the control area. To calculate the possibility of correlation response from a change in surface shape and its orientation with respect to its initial position, it is necessary to know the amplitude bandpass. The collimated light flux of the source formed by an optical system passes through an encoding grid and hits the surface of the sensed article. A pattern is observed on the article which is uniquely related to the curvature of the surface and viewing angle. A lens forms an image of the surface being inspected and this is transmitted to the input of the data processing channel. The method of automatically checking the shape of complex surfaces has a relative sensitivity on the order of 10^{-3} to 10^{-4} , permitting inspection of articles with second class of accuracy. Deviation of orientation of an article in its control position by 10 to 15 angular minutes has almost no effect on inspection quality. 4 figures; references 5: 3 Russian, 3 Western.

SCATTERING OF LIGHT BY DIFFUSE QUADRATIC SURFACES IN PHOTOMETRIC REPRESENTATION

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 11-13 manuscript received 10 Mar 78

TOMKUL, V. M. and SHURA, YU. A.

[Abstract] The study of problems of reflection of light by diffuse objects of complex form and several questions of atmospheric optics and radiation meteorology involves the effect of light diffused by diffuse quadratic surfaces in the optical wavelengths in the representation of physical optics or in a geometric or photometric form. The operator method of calculating the luminous intensity scattered in a photometric representation by arbitrary diffuse quadratic surfaces is developed; based on the result, an analytical

formula is derived to calculate the three-dimensional distribution of luminous intensity scattered by an ellipsoid of revolution. In this analysis, the problem assumes that the surface is illuminated by a parallel beam of light and observation is made from a distance greatly exceeding the linear dimensions of the scattering object's surface. Reference 10: 6 Russian, 4 Western.

USSR

UDC 681.751

ALL-PURPOSE OPTICAL STRING

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 23-27 manuscript received 23 Dec 77

LEVIN, B. M. and VOLKOVA, T. A.

[Abstract] Optical sighting tubes are widely used in machine construction to monitor the shape and juxtaposition of surfaces. Internal lens-focused sighting telescope PPC-11 is the best known example: its systematic error is about $\pm 1''$ and it tends to increase during operation. The DP-477M optical string can be classified as a sighting telescope: it employs an axicon objective lens that does not require refocusing on its axially mobile mark. A new device, the OS3M was recently developed which has two independent channels: axicon sighting and autocollimation-type channels. The device is intended for monitoring rectilinearity, parallelism, perpendicularity of surfaces and coaxial alignment of apertures. It may be used as a sighting telescope, as an autocollimator, or as both. The optical axes of the sighting telescope and autocollimator are superposed. The axicon in the sighting channel stabilizes positioning of the sighting line in space. The combined use of sighting and autocollimation features of the device can be employed to solve a series of problems which could not be handled before by separate methods. 4 figures; references: 4 Russian.

RESULTS AND FUTURE DEVELOPMENT OF OPTICAL CERAMICS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 39-41 manuscript received 12 Apr 78

VOLYNETS, F. K.

[Abstract] Semicrystalline optical materials were born out of the needs of optical science and technology, especially with the popularization of television. Materials were required which had high mechanical strength and good transparency in the IR region: standard materials such as silicate glass and single crystals did not have these features. Polycrystalline materials had to be developed which had porosity 1-2 orders lower than tool ceramics, higher strength than KBr slabs, transparency in the IR region of 30-50 microns. The so-called "hot pressing" method of dispersed powder was developed to meet such requirements. Compaction kinetics was studied to determine the effect on those parameters. Study of the physical and chemical nature of manufacturing processes of optical ceramics by the method of recrystallization pressing suggested the possible production of luminescent optical ceramics for use in neutron, electron, X-ray, UV and IR emission imaging devices. Electro-optical ceramics are 3-4 orders faster than LC cells. Magneto-optical ceramics are also promising. 1 figure.

CHOICE OF CONDITIONS FOR MACHINING LARGE SIZE OPTICAL BLANKS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 45-49 manuscript received 14 Mar 78

BOGDANOV, A. P., TSESNEK, L. S. and IVANOV, V. A.

[Abstract] Increased accuracy and reduced time and labor-intensiveness of manufacturing the surfaces of large optical items are requirements usually linked with the accuracy of predicting wear in grinding and polishing. In view of the fact that there are new methods for machining large blanks with a lap or flexible tool, there is certainly a great deal of interest in control of the shaping process by means of calculating machining conditions. The theoretical accuracy of calculations has a maximum deviation of ± 0.6 microns. During grinding there is a redistribution of contact pressure in the region of the blank and tool surface contact due to the passage of the tool beyond the edge of the blank. Since these wear patterns are regular,

there are mathematical methods of avoiding the "hump" near the edge of the blank by making certain adjustments in tool pressure and angle. In polishing there is instability in the rate of rotation of the tool: where this instability is great it is difficult to predict the surface shape. 2 figures; references: 3 Russian.

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UDC 535.537.29:548.0

USE OF LEAD MAGNESIUM NIOBATE CRYSTALS TO CONTROL OPTICAL EMISSION

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 52-55 manuscript received 9 Mar 78

BEREZHEVOY, A. A., KOROLEV, YU. G., POPOV, YU. V., SIDORENKO, N. B. and
SHERSTNEVA, T. N.

[Abstract] The use of lasers in data storage and transmission systems is directly linked with effective methods of controlling optical emission. Methods employing the nonlinear nature of the medium's optical susceptibility occurring in an electrical field are particularly important. Crystals in which a diffused ferroelectric phase transition is observed have the greatest operational possibilities. The polarization features of these crystals by the external field places them in a new class of electrooptical materials: they have high electrooptical coefficients and retain optical isotropy in a wide temperature range. An interesting effect of practical value is the quadratic longitudinal electrooptical effect which appears in such a way that the control voltage decreases in direct proportion to the thickness of the crystal in the direction of light propagation. This particular feature made it possible to develop three-dimensional light modulators using light control. In tests, images were sensed using a polarization microscope in a converging beam; lead magnesium niobate crystals were tested in particular: resolution obtained was 20 lines per millimeter, but this does not represent the limiting possibilities of the crystal. 3 figures; references 15: Russian.

INFRARED TV FOR QUALITY CONTROL IN ASSEMBLY OF ELECTRIC MACHINE STATORS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 74-75 manuscript received 19 Apr 78

MIRONSHNIKOV, M. M., IVANOVA, R. N., RUDAKAS, P. P., ZHUKOV, R. A. KARAPETYAN, K. S. and MOZINA, T. D.

[Abstract] Much attention has been given lately to nondestructive testing of industrial items during manufacture and operation, including the use of the thermovision method of quality control for assembling stators in electrical machinery. A rotating scanner performs an element-by-element circular scan of the inner surface of the test stator. IR emission from the surface is focused by the lens on a sensitive area of a photoresistor. If there is a temperature difference between two contiguous surface elements, an electrical signal is generated proportional to this difference; this signal is fed to a recording input where a B/W halftone image of the object is printed in the form of a thermal map. The objective is a three-lens compound with a relative aperture of 1.33, focal length of 133.6 mm and magnification of 0.2. Resolution of the thermovisor is 20 angular minutes. The thermovisor contains an optical head and a recording unit interconnected via an electric cable. This device can also be used to study the thermal field of surfaces of various cylindrical items. 3 figures; references 3: Russian.

LABORATORY DEVICE FOR SPUTTERING REFRACTORY MATERIALS WITH AXISYMMETRIC ELECTRON SOURCE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978
pp 75-75 manuscript received 13 Apr 78

BALAKOV, A. V. KINSHINA, YE. A. and MORICHEV, I. YE.

[Abstract] The electron beam evaporator is intended for sputtering films of refractory materials in small vacuum devices, without the usual armature contamination. The electron gun with its tungsten cathode and Pierce electrodes shapes the beam which is focused by an electromagnetic lens on the surface of the material in a 3 x 5 mm spot. Using a deflection system, the beam may be moved in two mutually perpendicular directions. Focusing and deflection elements are outside of the vacuum envelope, permitting the use of standard TV systems. The evaporator was used to sputter various materials used in the

production of dielectric coatings. The advantages of sharp focusing of electrons shows up most clearly in the evaporation of sublimating materials with low thermal conductivity such as ZnS and ZrO_2 . Spectral emission analysis of the composition of films showed them to virtually lack contaminants usually introduced by an evaporator armature. The concentration of impurities of iron, nickel and chromium in the films corresponds to their content in the initial material and is roughly two orders lower than in films produced using the annular type EVR-211 evaporator manufactured by Balzers. 2 figures; references 4: Russian.

USSR

UDC 621.317.732:536.51

AN AUTOMATIC INSTALLATION FOR MEASUREMENT OF THERMOELECTROMOTIVE FORCE AND ELECTRIC RESISTANCE IN THE 60-400 K TEMPERATURE RANGE

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 3, Mar 79 pp 20-22

CHECHERSKIY, V. D. and ROMANOV, V. P.

[Abstract] The authors have developed an automatic installation for the study of the mechanisms of conductivity in magnetic semiconductors, allowing measurement of ρ and α in the 60-400 K temperature interval. A block diagram of the device is presented. The installation contains two measuring instruments, the temperature and thermo-emf being recorded simultaneously. In order to improve reproducibility of results, identical experimental conditions are created for relative measurements and the number of measuring instruments is reduced. The temperature gradient along the specimen is automatically stabilized. Figures 2; references 3 (Russian).

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